Meeting of the Florida Chapter of the Acoustical Society of America, University of Central Florida, Cocoa, FL, October 27, 2017

DSP Synthesis Algorithm for Generating Florida Scrub Jay Calls

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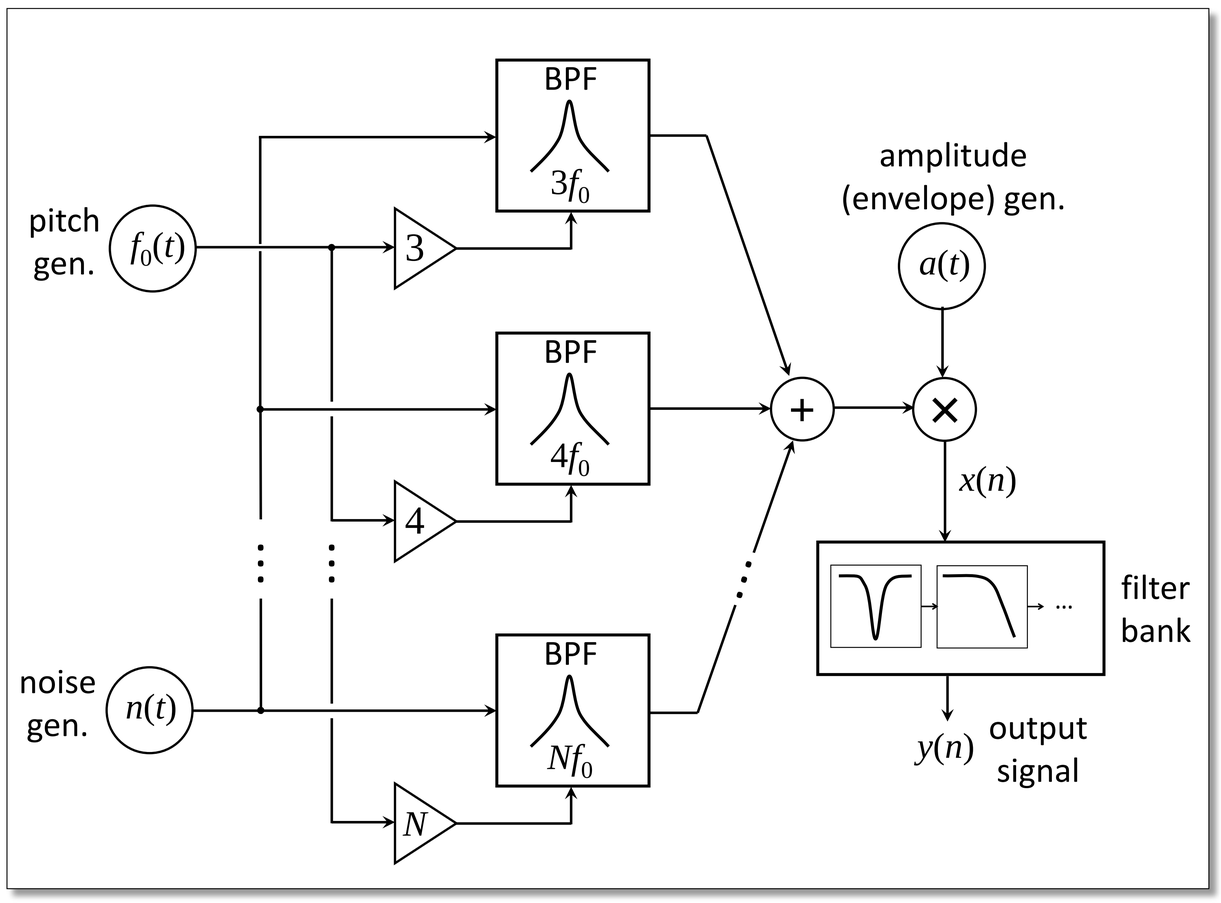
ABSTRACT

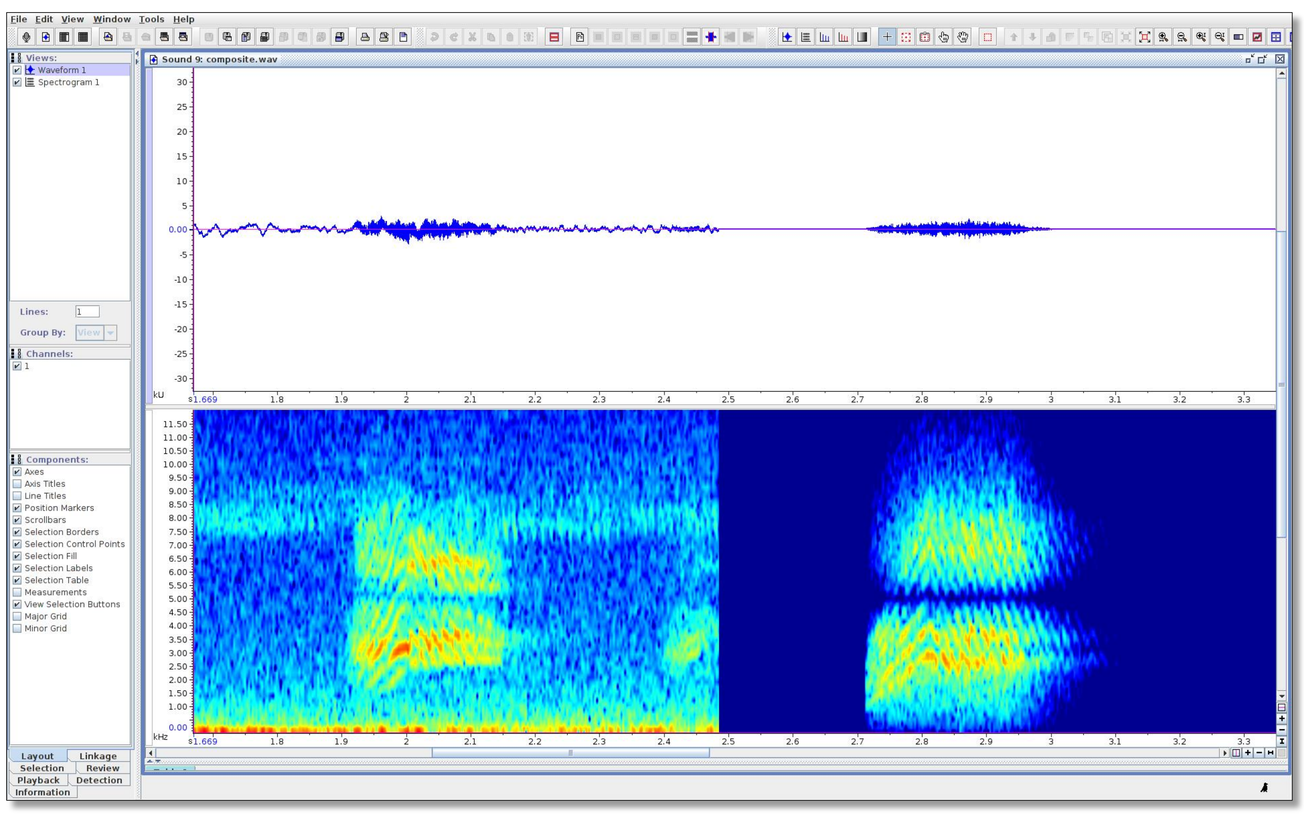
A prototype digital signal processing (DSP) algorithm has been developed to approximate Florida scrub jay calls. The Florida scrub jay (*Aphelocoma coerulescens*), believed to have been in existence for 2 million years, living only in Florida, has a complicated social system that is evident by examining the spectrograms of its calls. Audio data was acquired at the Helen and Allan Cruickshank Sanctuary, Rockledge, Florida during the 2016 mating season using three digital recorders sampling at 44.1 kHz. The synthesis algorithm is a first step at developing a robust identification and call analysis algorithm. Since the Florida scrub jay is severely threatened by loss of habitat, it is important to develop effective methods to monitor their threatened population using autonomous means.

Florida scrub jay with identification bands.



Florida scrub jay call synthesis algorithm.

Digital recorders and tripods used to acquire audio data.



Spectrogram of Type I call: (left) recording, (right) synthesis algorithm.

ALGORITHM DESCRIPTION

The synthesis algorithm is based on observations that the calls consist of two primary types, where each type may consist of variations of the primary. The two types are characterized by the envelop width, where a Type I call is approximately 0.25 ms in duration and Type II is 0.15 ms wide. The audio signal within the audio envelop has a frequency range from about 100 to 10000 Hz. The synthesis algorithm may possibly be associated with the biological call generation mechanisms, but a musical instrument analogy is more apparent where a generated continuous pitch sequence within a musical measure can describe the calls. With the musical instrument analogy in mind, the synthesis algorithm consists of a continuous fundamental frequency $f_0(t)$ as a function of time within a envelope, modified by an output filter response. The filter response appears to be constant in time and may be a characteristic of some part of the jay's speech generation mechanism. The output filter is synthesized using a 4^{th} order band stop filter with a constant $f_0 = 5.1$ kHz and a 4^{th} order low pass filter with $f_c = 6.5$ kHz. Additional filter sections may be added in future versions as the algorithm is improved.